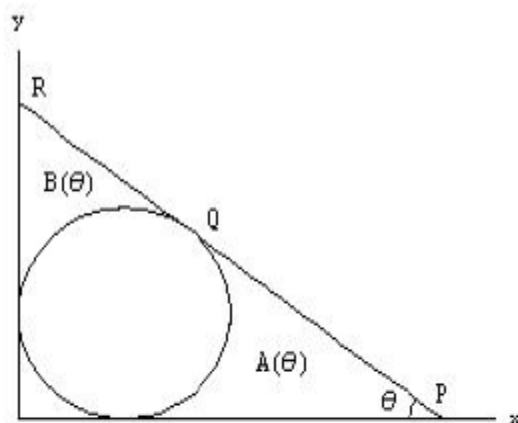


In the diagram below is sketched the circle with centre  $(1, 1)$  and radius 1 and a line  $L$ . The line  $L$  is tangential to the circle at  $Q$ ; further  $L$  meets the  $y$ -axis at  $R$  and the  $x$ -axis at  $P$  in such a way that the angle  $OPQ$  equals  $\theta$  where  $0 < \theta < \pi/2$ .



(i) Show that the co-ordinates of  $Q$  are

$$(1 + \sin \theta, 1 + \cos \theta),$$

and that the gradient of  $PQR$  is  $-\tan \theta$ .

Write down the equation of the line  $PQR$  and so find the co-ordinates of  $P$ .

(ii) The region bounded by the circle, the  $x$ -axis and  $PQ$  has area  $A(\theta)$ ; the region bounded by the circle, the  $y$ -axis and  $QR$  has area  $B(\theta)$ . (See diagram.)

Explain why

$$A(\theta) = B(\pi/2 - \theta)$$

for any  $\theta$ .

Calculate  $A(\pi/4)$ .

(iii) Show that

$$A\left(\frac{\pi}{3}\right) = \sqrt{3} - \frac{\pi}{3}.$$